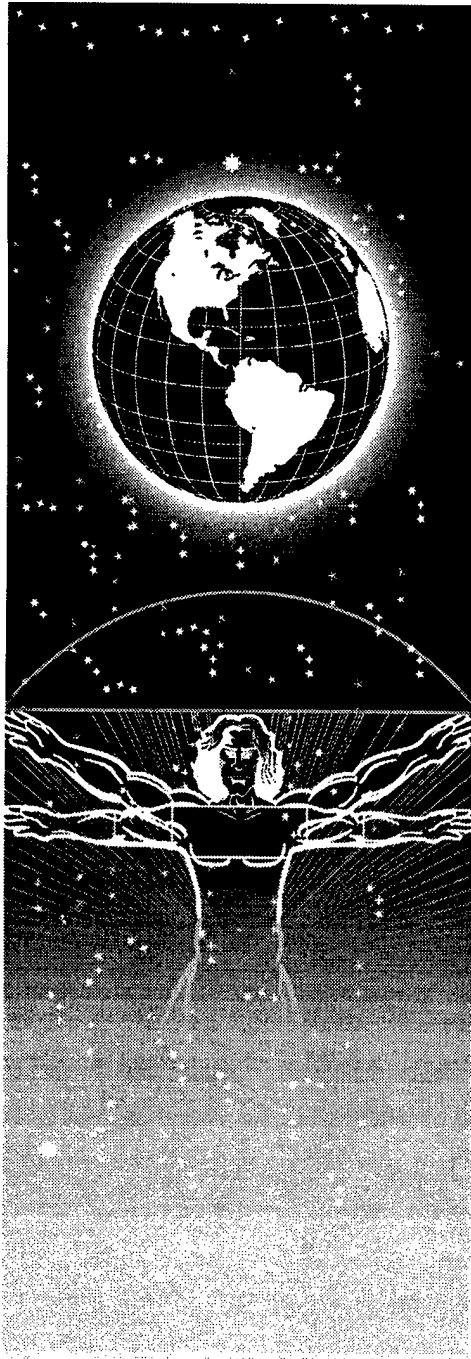


UNITED STATES AIR FORCE
ARMSTRONG LABORATORY



THE CG DATASET: WHOLE BODY
SURFACE SCANS OF
53 SUBJECTS (U)

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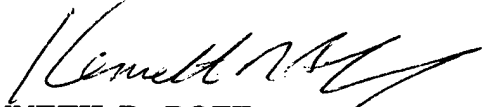
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The voluntary informed consent of the subjects used in this research was obtained as required by Air Force Instruction 40-402.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



KENNETH R. BOFF, Chief
Human Engineering Division
Armstrong Laboratory

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Preface

This research was conducted by the Computer Anthropometric Research and Design (CARD) Laboratory of the Human Engineering Division, Crew Systems Directorate, Armstrong Laboratory, Wright-Patterson Air Force Base, Ohio. The work was performed under the Scientific Visualization of Anthropometry for Research and Design (SVARD) contract Number F41624-93-C-6001.

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Table of Contents

1.0	The CG Dataset	1
1.1	The Cyberware WB4	1
1.2	Subject Selection	1
1.3	Scanning Procedure	2
1.4	Scanning Postures	2
1.5	Scan Files	4

List of Figures

Figure 1.	Height to Stature Ratios	1
Figure 2.	The Scanning Postures	3

List of Tables

Table 1.	File Naming Convention	4
Table 2.	Scan Files	4

Appendix

Appendix A	Anatomical Landmarks	5
Appendix B	Measurement Definitions	7
Appendix C	CG Anthropometric Measurements	13
Appendix D	List of all zippered files	22

1.0 THE CG DATASET: WHOLE BODY SURFACE SCANS OF 53 SUBJECTS

The Center of Gravity (CG) dataset contains approximately 159 surface scans of 24 male and 29 female subjects. Each subject is represented by three scans: one standing scan and two seated scans. The scans were collected at the Computerized Anthropometric Research and Design (CARD) Laboratory with the Cyberware WB4 whole body scanner.

1.1 The Cyberware WB4

The Cyberware WB4 is one of the first scanning systems to generate high resolution data of the surface of the human body. The scanner has four scanning heads that project a horizontal laser line on the subject, who sits or stands on a round platform mounted on the scanner frame. The scanner heads “see” a cylindrical area 2 meters high and 1.2 meters wide (roughly the diameter of the platform on which the subject is positioned). The subject’s entire body is scanned within 17 seconds. When the scan is complete, the digitized images are “zippered.” Zippering merges the four raw data files produced by each scanning head.

1.2 Subject Selection

Subjects for the CG dataset were selected based on their weight-to-stature and sitting height-to-stature ratios. Figure 1 is the sitting height to stature ratio of the subjects with 95% bivariate confidence ellipse.

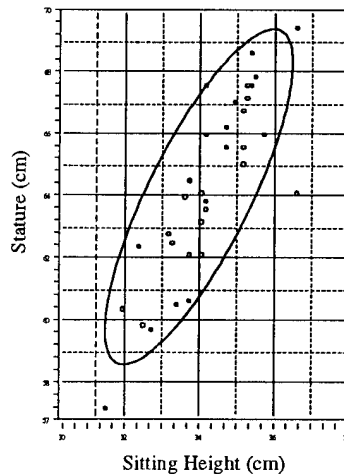


Figure 1. Height to Stature Ratios

1.3 Scanning Procedure

The scanning procedure included dressing the subject in standardized clothing, landmarking the subject, taking traditional measurements, and positioning the subject on the scanning platform. The standard scanning apparel for both men and women includes light-gray cotton biker shorts, and a gray sports bra for women. Latex caps were worn to cover the hair and provide a more accurate shape of the head. Landmarking is the process of identifying and positioning sticky blue markers four millimeters wide on the subject to identify the landmarks in the scanned images. Seventy-six anatomical landmarks were placed on each subject. Appendix A contains a complete list of the landmarks. Traditional measurements were made using anthropometers and tape measures. A description of the measurements is located in Appendix B; the traditionally measured values for each subject are in Appendix C.

CARD Lab researchers initially used 99 anthropometric variables to determine the relationship between traditional anthropometry postures and proposed scanning body postures. The list of variables were compiled through meetings with representatives from the automotive, clothing, and aerospace industries.

1.4 Scanning Postures

As in traditional anthropometric measurement, two main postures were scanned: the standing posture (filename ending in **a**) and the sitting posture (filename ending in **c**). An additional seated posture (filename ending in **b**) was used to maximize the body surface coverage by the scanner (see Figure 2).

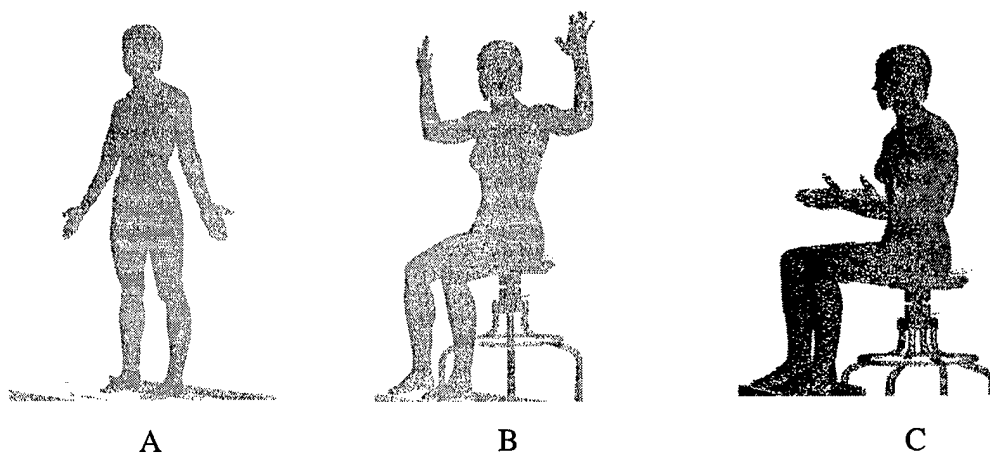


Figure 2. The Scanning Postures

The following paragraphs describe the scanning postures:

STANDING (A)

1. Feet on footpads. Outer edges of feet aligned to outside of footpads (35 cm apart).
2. Standing erect with the height marker on the top-of-head dot (the dot is the highest point with the head in Frankfurter Horizontale).
3. Arms slightly abducted. Fingers pointing at the edge of the force plate.
4. Arms exorotated, palms in frontal plane. The fingers are together, and the thumb is separated.

SITTING 1 (B): optimal exposure

1. Sitting erect on a stool.
2. Feet on block, aligned with hip.
3. Knee angle slightly more than 90 degrees.
4. Arms 90 degrees abducted, elbows flexed 90 degrees, lower arms in frontal plane, fingers spread.

SITTING 2 (C): optimal link to traditional measures

1. Sitting erect on a stool.
2. Feet on block, aligned with hips.
3. Knee angle 90 degrees.
4. Upper arms against body, elbows flexed 90 degrees, lower arms in sagittal plane, fingers together, thumb apart.

The three scanning positions for each subject are identified by adding **a**, **b**, or **c** to the end of the filename.

Table 1. File Naming Convention

Subject Number	Scanned Files	Measurement File
1	cg01a, cg01b, cg01c	mp001

1.5 Scan files

Several types of files are created from the Cyberware scanner and the Cypie merging software. The Cyberware scanner produces two unzipped or raw data files for each scanning head; they contain the range and color information (see table 1). Table 2 lists all the files that are created during a single scan. The file sizes range from 100 kilobytes for the raw color file to almost 9 megabytes for the merged file (see Table 1). The Cypie software creates the zippered file (cg07a.ply, for example) by merging the color and range data files from the unzipped files. Appendix D contains a list of all the zippered files.

Table 2. Scan Files

Sample File Names	Zippered / Unzippered	Color / Range /Both	Scanning Head	File Size (megabytes)
cg07a-000.ply	Unzippered	Range	Head 0	2-3
cg07a-000.ply.color	Unzippered	Color	Head 0	0.1-0.2
cg07a-075.ply	Unzippered	Range	Head 1	2-3
cg07a-075.ply.color	Unzippered	Color	Head 1	0.1-0.2
cg07a-180.ply	Unzippered	Range	Head 2	2-3
cg07a-180.ply.color	Unzippered	Color	Head 2	0.1-0.2
cg07a-255.ply	Unzippered	Range	Head 3	2-3
cg07a-255.ply.color	Unzippered	Color	Head 3	0.1-0.2
cg07a.ply	Zippered	Both	All Heads	5-9

APPENDIX A

ANATOMICAL LANDMARKS

#	Segment	Landmark	#	Segment	Landmark
1	Head	Glabella	39	Thigh	Left Suprapatella
2		Sellion	40		Left Mid-Patella
3		Left Infraorbitale	41		Right Femoral Medial Epicondyles
4		Left Tragion	42		Right Femoral Lateral Epicondyles
5		Left Gonion	43		Right Suprapatella
6		Right Infraorbitale	44		Right Mid-Patella
7		Right Tragion	45	Calf	Left Tibiale
8		Right Gonion	46		Left Medial Malleolus
9		Nuchale	47		Left Lateral Malleolus
10		Menton	48		Right Tibiale
11	Neck	Cervicale	49		Right Medial Malleolus
12		Adam's Apple	50		Right Lateral Malleolus
13	Thorax	Suprasternale	51	Foot	Left Metatarsal-Phalangeal I
14		Substernale	52		Left Metatarsal-Phalangeal V
15		Left Clavicale	53		Left Posterior Calcaneous
16		Left Acromion	54		Right Metatarsal-Phalangeal I
17		Left Axilla Proximal	55		Right Metatarsal-Phalangeal V
18		Left Axilla Distal	56		Right Posterior Calcaneous
19		Right Clavicale	57	Upper Arm	Left Humeral Medial Epicondyle
20		Right Acromion	58		Left Humeral Lateral Epicondyle
21		Right Axilla Proximal	59		Left Olecranon
22		Right Axilla Distal	60		Right Humeral Medial Epicondyle
23	Abdomen	10th Rib Mid Spine	61		Right Humeral Lateral Epicondyle
24		Pst Waist @ Omphalion	62		Right Olecranon
25		Left 10th Rib	63	Forarm	Left Radiale
26		Right 10th Rib	64		Left Ulnar Styloid
27	Pelvis	Left ASIS	65		Left Radial Styloid
28		Left ilio-cristale	66		Right Radiale
29		Left PSIS	67		Right Ulnar Styloid
30		Left Trochanterion	68		Right Radial Styloid
31		Right ASIS	69	Hand	Left MP joint II
32		Right ilio-cristale	70		Left MP Joint V
33		Right PSIS	71		Left Metacarpale III
34		Right Trochanterion	72		Left Dactylion
35		Crotch	73		Right MP Joint II
36	Thigh	Gluteal Furrow	74		Right MP Joint V
37		Left Femoral Medial Epicondyles	75		Right Metacarpale III
38		Left Femoral Lateral Epicondyles	76		Right Dactylion

APPENDIX B

MEASUREMENT DEFINITIONS

ACROMIAL HEIGHT

The vertical distance between a standing surface and the acromion landmark on the tip of the right shoulder is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is made at the maximum point of quiet respiration.

ACROMIAL HEIGHT, SITTING

The vertical distance between a sitting surface and the acromion landmark on the tip of the right shoulder is measured with an anthropometer. The subject sits erect looking straight ahead. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The measurement is made at the maximum point of quiet respiration.

ANKLE CIRCUMFERENCE

The minimum horizontal circumference of the right ankle is measured with a tape. The subject stands with the feet about 10 cm apart and the weight distributed equally on both feet.

AXILLA HEIGHT

The vertical distance between a standing surface and the right axillary fold, as designated by the axilla landmark, is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed with the palms facing the thighs. The measurement is taken at the maximum point of quiet respiration.

BIACROMIAL BREADTH

The distance between the right and left acromion landmarks at the tips of the shoulders is measured with a beam caliper. The subject sits erect. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The measurement is taken at the maximum point of quiet respiration.

BICEPS CIRCUMFERENCE, EXTENDED

The circumference of the right upper arm around the biceps muscle is measured with a tape held perpendicular to the long axis of the upper arm. The subject stands erect. The shoulders and upper extremities are relaxed with the palms facing the thighs. The tape is placed at the biceps landmark for the measurement.

BICEPS CIRCUMFERENCE, FLEXED

The circumference of the right upper arm around the flexed biceps muscle is measured with a tape held perpendicular to the long axis of the upper arm. The subject stands with the upper arm extended forward horizontally and the elbow flexed 90 degrees. The fist is clenched and held facing the head, and the subject exerts maximum effort in "making a muscle." The tape is placed on the drawn biceps landmark.

BUTTOCK DEPTH

The horizontal depth of the torso at the level of the maximum protrusion of the right buttock is measured using a beam caliper. The subject stands erect with the heels together and the weight distributed equally on both feet.

BUTTOCK-KNEE LENGTH

The horizontal distance between the maximum protrusion of the right buttock and the anterior point of the right knee is measured with an anthropometer. The subject sits erect. The thighs are parallel and the knees flexed 90 degrees with the feet in line with the thighs.

CALF CIRCUMFERENCE

The maximum horizontal circumference of the right calf is measured with a tape. The subject stands erect with the heels approximately 10 cm apart and the weight distributed equally on both feet.

CHEST BREADTH

The maximum horizontal breadth of the chest at the level of the right bustpoint on women or the nipple on men is measured with a beam caliper. The subject stands erect looking straight ahead with the heels together, the weight distributed equally on both feet. The measurement is taken at the maximum point of quiet respiration. **NOTE:** Breast tissue and latissimus dorsi muscle tissue are **NOT** included in this measurement if they extend beyond the rib cage.

CHEST DEPTH

The horizontal distance between the chest at the level of the right bustpoint on women or the nipple on men, and the back at the same level is measured with a beam caliper. The subject stands erect looking straight ahead. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

ELBOW CIRCUMFERENCE

The circumference of the right elbow in a plane perpendicular to the long axis of the arm is measured with a tape passing around the elbow at the level of the olecranon process of the ulna. The subject stands with the arm straight and held slightly away from the side. **NOTE:** The subject should not hyperextend the elbow.

FOOT BREADTH

The maximum breadth of the right foot is measured with a beam caliper. The subject stands with the feet about 10 cm apart, and the weight distributed equally on both feet. The caliper blades are placed on the maximum protrusions of the sides of the foot, in the region of the first and fifth metatarsophalangeal joints.

FOOT LENGTH

The maximum length of the right foot is measured with a beam caliper. The subject stands with the feet about 10 cm apart, and the weight distributed equally on both feet. One blade of the caliper is placed on the posterior protrusion of the heel, the pternion landmark, and the other is placed on the tip of the longest toe, acropodion.

FOREARM CIRCUMFERENCE, MAXIMUM EXTENDED

The maximum circumference of the right forearm is measured with a tape. The tape is held perpendicular to the long axis of the forearm. The subject stands erect, with the shoulders and upper extremities relaxed.

FOREARM-HAND LENGTH

The horizontal distance between the back of the tip of the right elbow to the tip of the right middle finger is measured with a beam caliper. The subject stands erect with the upper arms hanging at the sides and the right elbow flexed 90 degrees. The hand is held out straight with the palm facing inward.

HAND BREADTH

The breadth of the right hand between the landmarks at metacarpale II and metacarpale V is measured with a sliding caliper. The subject holds the hand flat, palm down, with the fingers together and the thumb abducted. The middle finger is parallel to the long axis of the forearm.

HAND DEPTH

The depth of the right hand measured at metacarpale III is measured with a spreading caliper. The subject holds the hand flat, palm facing inward (index finger side is up) with the fingers together and the thumb abducted. The middle finger is parallel to the long axis of the forearm.

HAND LENGTH

The length of the right hand between the distal crease on the palmar surface of the wrist and the tip of the middle finger (dactylion III) is measured with a sliding caliper. The subject holds the hand flat, palm up, with the fingers together and the thumb abducted. The middle finger is parallel to the long axis of the forearm.

HEAD BREADTH

The maximum horizontal breadth of the head above the level of the attachment of the ears is measured with a spreading caliper. The subject is approached from the rear with the caliper. Using light pressure the anthropometrist moves the caliper tips in a circular pattern (approximately 2 cm. in diameter) until the maximum value is observed.

HEAD LENGTH

The distance from the glabella landmark between the browridges to the posterior point on the back of the head is measured with a spreading caliper.

HIP BREADTH

The maximum horizontal distance between the hips is measured with a beam caliper. The subject stands erect with the heels together and the weight distributed equally on both feet.

KNEE CIRCUMFERENCE

The horizontal circumference of the right knee at the level of the midpatella landmark is measured with a tape. The subject stands erect with the heels approximately 10 cm apart, and the weight distributed equally on both feet.

KNEE HEIGHT, SITTING

The vertical distance between a footrest surface and the suprapatella landmark at the top of the right knee (located and drawn while the subject stands) is measured with an anthropometer. The subject sits with the thighs horizontal and parallel to each other, the knees flexed 90 degrees, and the feet in line with the thighs.

LATERAL MALLEOLUS HEIGHT

The vertical distance between a standing surface and the lateral malleolus landmark on the outside of the right ankle is measured with a headboard gauge. The subject stands erect with the heels together and the weight distributed equally on both feet.

MENTON - TOP OF HEAD HEIGHT

The vertical distance from the menton landmark on the base of the chin to the top of the head is measured using a headboard gauge and a horizontal surface placed on the subject's head. The subject stands erect, with the head in the Frankfort plane. The measurement should be performed using a NATO type headboard, if it is available. If a headboard is unavailable, a 25 square centimeter board may be used. In this case, a level is used to maintain the board in a horizontal position.

NECK CIRCUMFERENCE

The maximum circumference of the neck at the level of the thyroid landmark (Adam's apple) is measured with a tape. The plane of the measurement is perpendicular to the long axis of the neck. The subject stands erect with the head in the Frankfort plane. The shoulders and upper extremities are relaxed.

SHOULDER-ELBOW LENGTH

The distance between the acromion landmark on the tip of the right shoulder and the olecranon landmark on the bottom of the right elbow is measured with a beam caliper held parallel to the long axis of the upper arm. The subject stands with the right upper arm hanging at the side and the elbow flexed 90 degrees. The finger are extended and the palm faces inward.

SITTING HEIGHT

The vertical distance between a sitting surface and the top of the head is measured with an anthropometer. The subject sits erect with the head in the Frankfort plane. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The thighs are horizontal and parallel to each other, the knees are flexed 90 degrees and the feet are in line with the thighs. The measurement is made at the maximum point of quiet respiration.

STATURE

The vertical distance from a standing surface to the top of the head is measured with an anthropometer. The subject stands erect with the head in the Frankfort plane. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

THIGH CIRCUMFERENCE

The circumference of the right thigh at its juncture with the buttock is measured with a tape. The measurement is made perpendicular to the long axis of the thigh. The subject stands erect with the weight distributed equally on both feet. The legs are spread apart just enough so that the thighs do not touch.

WAIST BREADTH

The horizontal breadth of the waist at the level of center of the navel (omphalion) is measured with a beam caliper. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The measurement is taken at the maximum point of quiet respiration.

WAIST DEPTH

The horizontal distance between the front and back of the torso at the level of the center of the navel (omphalion) is measured with a beam caliper. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The measurement is taken at the maximum point of quiet respiration.

WAIST HEIGHT (OMPHALION)

The vertical distance between a standing surface and the center of the navel (omphalion) is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is made at the maximum point of quiet respiration.

WEIGHT

The weight of the subject is taken to the nearest tenth of a kilogram or quarter of a pound. The subject stands in the center of the platform of a scale.

WRIST CIRCUMFERENCE

The circumference of the wrist perpendicular to the long axis of the forearm is measured with a tape passing over the stylium landmark on the wrist. The subject extends the right arm forward with the palm up.

APPENDIX C

CG ANTHROPOMETRIC
MEASUREMENTS

Subj.	Age	Race	Sex	Weight	Stature	Acromial	Axilla	Waist
MP001	33	1	F	140.3	172.5	143.7	130.2	103.7
MP002	23	1	F	137.8	159.6	130.6	119.8	96.7
MP003	29	1	F	158.3	166.5	135.8	125.4	100
MP004	21	1	F	137.8	168.1	136.6	127	103.3
MP005	22	1	M	148	166.4	134.1	123.1	100.9
MP006	23	5	M	124.8	163.4	131.7	120.4	96.2
MP007	22	1	F	113.8	165.1	131.4	121.5	96.3
MP008	27	1	F	142.8	174.4	144.3	132.8	107.5
MP009	24	1	F	115	162.4	130.8	120.4	96.2
MP010	26	1	M	169.3	173.5	142.2	130.6	106.6
MP011	20	1	M	201.3	187.7	153.6	141.5	116.4
MP012	43	1	M	172.9	174.2	143.9	132.2	104.7
MP013	25	1	F	124.5	162.2	134.4	119.7	97.6
MP014	20	1	F	146.5	166.4	134	123.9	99.5
MP015	23	5	F	148.5	169.5	139.5	125.9	103.9
MP016	21	1	M	157.9	175.5	142.8	132.1	103.6
MP017	27	1	F	127.8	157.7	128.6	115.6	93.5
MP018	27	1	M	161	179.9	146	133.7	107.1
MP019	33	1	F	149.5	172.2	140.5	130.2	106.3
MP020	30	4	F	135.8	162.6	132.5	120.3	97
MP021	32	1	M	204.9	185.5	150.9	138.4	110.9
MP022	33	1	F	137.5	161.9	132.4	119.8	99.8
MP023	24	1	M	236.3	194.4	163.7	149.9	119.7
MP024	20	1	F	153	170.7	142	131.8	104.8
MP025	41	1	M	230.8	183	151.4	138.4	109.4
MP026	22	1	F	145.3	163.7	134.5	123.1	99.1
MP027	27	1	M	214.8	182.3	151.4	138.9	110
MP028	24	1	M	157	184.4	149.6	137.2	109.1
MP029	39	1	M	181.5	171	140.1	127.5	99.5
MP030	20	1	M	208.3	188.4	154.2	142.5	118.6
MP031	21	1	F	140.3	162.6	133.1	121	99.3
MP032	21	3	M	147	177.1	142.4	131.9	105.3
MP033	27	1	F	153	167.5	137.3	125.9	99
MP034	32	1	F	140.8	157.9	129.6	120.1	93.7
MP035	33	4	M	153.1	175.2	143.3	132.2	104.2
MP036	26	1	F	133.8	170.2	140.2	129.7	103
MP037	27	1	F	102.8	151.7	122.2	113.3	88.9
MP038	27	3	F	138.5	167.4	136.5	126.5	100.6
MP039	38	1	F	95.8	145.7	116.9	107.9	84.7
MP040	32	1	M	169.2	166.3	135.7	123.6	97.5
MP041	35	1	F	121.5	160.6	133	122.3	94.1
MP042	26	1	M	186.4	177.4	145.8	134.5	108.2
MP043	35	1	M	167.1	170.5	141	129.6	101.3
MP044	20	1	F	119.8	176.6	144.1	134.3	107.9
MP045	23	1	F	135.5	171.6	139.1	130.1	105.3
MP046	26	1	M	170	182	147	134.5	112
MP047	20	4	F	113	154.4	123	114.1	91.1
MP048	35	1	F	110	153.7	122.1	113	90.2
MP049	30	1	M	172.9	172.6	141	128.4	103.5
MP050	25	1	M	147.8	169.1	139.9	128.5	102

CG ANTHROPOMETRIC
MEASUREMENTS

Subj.	Age	Race	Sex	Weight	Stature	Acromial	Axilla	Waist
MP051	29	1	M	188.9	177.2	146.8	134.2	107.3
MP052	41	1	M	199	180.2	146.3	132.2	106.4
MP053	22	1	M	192	187.1	154.5	141.4	113.3
MP054	24	1	F	118.8	158.5	129.1	121.7	95.9
MP055	35	1	M	185.3	178.6	146.7	134.5	109.1
MP056	31	1	F	105.3	159	130.4	120.5	94.4
MP057	28	5	M	142	164.5	133.1	122.1	96.6
MP058	28	1	F	126	171.5	140.7	130.3	104.9
MP059	27	1	F	110.5	152.8	125.1	115.7	91.1
MP060	37	2	M	168.3	180.5	149	136.9	110.7
MP061	33	1	F	101.8	151.5	121.3	113.1	86.9
MP062	26	1	M	117.6	168.8	138.9	128.4	101.6
MP063	24	1	M	172.8	185.3	153	140.8	111.7

CG ANTHROPOMETRIC
MEASUREMENTS

Subj.	Biacromial	Chest	Waist	Hip	Chest	Waist	Buttock	Shoulder	Forearm	Lateral Mal	Foot Lth	Foot Bdth
MP001	37.7	28.6	27.6	35.3	22.4	18.1	21.2	36.3	45.8	6	24.1	9.6
MP002	38	27.6	27.5	35.9	24.3	18.5	23.7	33.6	43.7	6.4	23	8.7
MP003	38.4	30.5	30.3	39.3	25.8	20.7	25.5	34	43.3	6.4	23.3	8.6
MP004	37.2	28.6	31.3	36.3	24.7	18.3	23.2	33.2	44.7	6.4	25.3	9.6
MP005	39.9	30.2	29.1	33.3	22.6	19.6	24.6	34.6	45.1	6.1	25.2	9.1
MP006	37.5	28.6	25	30.4	21.9	17	21.4	35	45.2	6.9	25.1	10
MP007	37.1	27.7	28.1	33	21.3	17.2	20	32.5	42.2	6.4	24.3	8.9
MP008	39.9	27.5	31.1	36	21.4	17.4	22.7	36.3	44.4	6.3	23.9	8.5
MP009	39.8	27.8	28	33	20.8	15.7	18.7	33.3	42.9	6.2	23	9
MP010	39.7	31.9	31.7	34.4	24.1	21.4	25.1	36.2	47.2	6.1	25	9.4
MP011	43.1	36.4	31.8	36.6	25.9	21.2	26.8	38.8	53	8	29	11.6
MP012	39.8	37.8	32.4	34.7	27.6	23.3	25.6	34.8	48.1	6.4	26.6	10
MP013	33.5	29.9	26.4	33.1	23.1	17.1	21.1	32.8	42.9	7.2	23.5	8.7
MP014	37.3	29	28.4	37.5	24.6	19.9	24.5	32.4	43.4	6.7	24.5	9.5
MP015	38.6	32.3	28.8	36.9	22.5	18.6	24.5	35.1	46.6	6.2	24.7	9
MP016	41.5	32	28.3	33.1	22.2	20.7	23.5	37.5	47.3	7.3	25.5	9.7
MP017	36.1	27.2	27.8	35.3	21	16.2	21.6	32.2	42.5	6	23.2	8.5
MP018	41.3	30.9	32.3	34	23.3	23.2	25.2	35.5	47.8	7.2	26	9.2
MP019	38.6	27.5	30.8	37.8	22.8	19.3	24.9	33.6	45.4	6.7	26	8.6
MP020	36.4	27.2	25.1	34.5	22.6	17.8	21.6	32.7	41.9	5.8	24.4	9.7
MP021	42.4	35.3	33.6	37.5	24.9	25.2	26.5	37.6	50.2	7	28.6	10.1
MP022	34.8	26.8	25.5	35.4	23	17.4	23.4	32.8	44.2	6.2	24.3	8.5
MP023	41.6	36.5	36.1	38.2	27.3	25.3	27	41.1	51.7	7.3	29	10.9
MP024	36.4	30.2	28	37	23.8	20.8	25.9	34.8	44	6.6	24.8	9.6
MP025	41.5	36.1	32.9	38.5	29.1	28.2	27.3	37.5	49.5	7	27.7	10.5
MP026	35.1	28.4	28.2	35.5	23.1	18.4	23.5	35	46	6.9	25.1	9.9
MP027	41.1	35.6	33.5	36.2	27.2	25.7	26.9	37.7	51.2	8.4	26.9	10.2
MP028	39.3	29.7	29	34.5	24.1	18.9	24.4	36.5	46.6	6.6	26.3	10
MP029	37.2	33.6	31.7	36	26.6	26.2	27.2	35.4	46.5	7.5	26	9.1
MP030	41.3	33.3	33.2	39.5	25.3	22.1	26.4	38.8	50.9	8.5	28.7	10.7
MP031	34.9	27	27	35	23.1	17.7	24	34.6	41.7	6.1	22.8	9.1
MP032	43.3	29.6	28.9	34.4	25	17.9	23.4	36.2	49.5	6.4	28.4	10.2
MP033	35.7	27.7	31.5	37	22.5	22	24.8	32.7	43.3	6.8	23.9	9.9
MP034	34.4	29.7	28.2	36.6	23.2	20.3	23.5	31.6	40.2	6.7	23.3	9.4
MP035	40.3	29.9	30	32.8	21.4	21.3	24	35.5	47.7	7.4	25.7	9.7
MP036	37.7	27.5	30.2	35.1	23.4	18.8	21.4	34.6	47	7.2	24.2	8.9

CG ANTHROPOMETRIC
MEASUREMENTS

Subj.	Biacromial	Chest	Waist	Hip	Chest	Waist	Buttock	Shoulder	Forearm	Lateral Mal	Foot Lth	Foot Bdth
MP037	33.2	24.9	23.8	33.3	18.4	16.9	21.6	30	39.4	5.8	21.2	8.2
MP038	36.8	28.5	31.6	38.2	23.5	20.9	23.5	34.5	44	6.1	24.3	8.9
MP039	33	26.4	25.1	30.2	21.3	20.6	20.1	27.6	38.3	5.5	21.1	8.4
MP040	38.9	33.8	32.9	35.4	24.7	26.5	26.4	33.4	43.5	6	23.4	8.7
MP041	34.9	26.7	29.1	32.9	22.8	21.6	22	33.5	42.1	7.2	22.4	8.9
MP042	40.7	33.4	34.4	35.6	24.2	24.2	26.7	36.6	48.7	8	26.6	10.3
MP043	40.8	31.4	30.7	32.9	22	22	24.7	34.4	46	7	25.1	9.9
MP044	38.2	26.4	25.4	33.8	18.5	15.8	19.7	38.1	45.6	6.9	24.3	8.7
MP045	38.5	27.2	25.5	35.1	21.2	16.8	21.5	35.3	45.9	6.7	24	8.5
MP046	42.8	31.2	28.2	32.6	22.4	19.7	24.3	35.9	49.7	7	27.2	9.9
MP047	34.8	26.5	24.3	32.2	19.4	17.1	20.2	31.2	39.7	6	22.3	8.6
MP048	33.3	25.8	25	35.1	23.3	17.6	19.3	30.3	39.9	6.4	21.8	9.5
MP049	41	33.7	30.6	34	23.7	21.7	24.7	35.3	47.8	6.2	27.6	9.9
MP050	38.2	30.8	28.9	33.1	22.4	20.7	25.3	33	43.8	6.7	25.1	10.1
MP051	42.1	34.4	32.9	35.7	26.8	20.6	23.8	36.8	47.5	7	26.2	10
MP052	41.1	36	32	34.2	25	21.9	26.2	35.7	48.4	7.2	26.1	9.9
MP053	44.6	31.8	33	37.3	23.4	20	24.6	36.3	47.8	8	26.7	10.2
MP054	36.4	27.1	29	35.1	21.3	18	21.7	32.7	42.3	6.1	23.5	8.3
MP055	42.4	33.7	31.5	37.5	26.7	23.7	23.8	38.8	48.9	7.5	27.4	9.9
MP056	32.1	24.1	23	31.9	19.5	15.4	18.7	31.2	41.8	6.2	22.5	8
MP057	37.2	31.4	28.6	33.1	20.1	18.2	22.1	32.9	42.4	6.2	24.6	9.5
MP058	37.5	27.4	28.3	34.6	21.4	17.9	19.2	35.2	45.9	6.6	23.9	8.5
MP059	35.5	26.6	29.7	33.6	20	18.2	21.6	29.7	40.9	6	23.6	8.8
MP060	41	31.2	26.6	33.5	21.6	22.6	26.1	36.7	48.5	6.3	26.5	9.9
MP061	33.9	26	26.6	33.4	18.1	17.5	17.7	29.4	37.9	6.5	21.2	8
MP062	37.4	27.9	25.7	29.8	20	16	19.1	34.2	45.6	6.3	23.3	8.4
MP063	39.2	29.1	29.2	37	22.2	19	23.5	37.8	50.2	6.8	27.4	9.6

CG ANTHROPOMETRIC
MEASUREMENTS

Subj.	Neck	Biceps E	Biceps F	Elbow	Forearm	Wrist	Thigh	Knee Mid	Calf	Ankle
MP001	32.4	25.8	28.3	23.7	24.1	15.4	56.8	36.9	38.2	24.2
MP002	30.7	27.4	29.5	27.3	25.8	14.8	59.9	35.2	39.4	22.8
MP003	34.9	28.8	30.3	25	25	15.4	64.5	37.7	38.6	23.5
MP004	31	24.1	25.1	22.8	22.1	15.6	54	36.1	34.7	26
MP005	35.4	28.8	31.2	24.8	25.9	15.5	57.1	35.3	36.9	24.2
MP006	34.7	24	26.6	23.7	24.4	15.7	51.2	33.8	35.1	24.1
MP007	31	22.9	24.1	20.6	21.7	14.4	51.5	34	34.2	22.8
MP008	32.7	25.8	28	24.1	25	15.5	58.8	37.9	37.1	24.6
MP009	31	25	28	22.5	22.7	14.8	52.8	33.4	34.5	23.7
MP010	38.5	32.6	35	27.2	28.3	16.2	60.4	37.5	36.6	26.1
MP011	38.6	31.9	34.8	30.1	30.2	19.4	61	42.8	42.7	30.1
MP012	39	31.7	33.2	26.5	26.9	16.8	56.3	37.2	34.6	25.6
MP013	30.5	26.6	26.9	24.9	24.4	16	53.6	34.4	33.7	22.7
MP014	32.8	27.6	29.1	24.1	24.8	15.5	62.2	37.4	37.2	24.2
MP015	32.3	28	29.3	24.7	24.2	15.5	59	36.2	35.9	24.1
MP016	37	31.2	32.6	25.9	27.4	16.9	57.4	36.7	36.2	25.4
MP017	34.5	26.4	27.8	23.8	24.3	14.3	57.1	35.4	38.2	28.6
MP018	36.9	29.1	32.4	25.3	25.7	16.7	54.1	36.4	35.4	25.2
MP019	33.6	27.6	28.5	24.3	24.5	14.8	64.4	36.6	36.9	24.5
MP020	33.1	26.3	28.8	23.3	24.5	15.5	58.5	36.6	39	24.7
MP021	39	32.5	33.6	27.5	28.9	17.8	60.8	40.5	40.5	27.5
MP022	32.2	28.9	31.9	23.1	24.2	14.3	63.2	36.8	38.7	23.5
MP023	37.9	34	35.7	30	30.4	18.5	66.6	42.9	43.2	30
MP024	32	29.5	30.3	24.5	24.9	15.9	62	37.8	36.2	24.8
MP025	41.1	39.8	41.1	30.5	30.8	17.7	64.4	43.5	41	28.7
MP026	33	27.5	28.8	24.2	24.8	15.6	60.6	38.6	38.8	24.6
MP027	39.5	36.9	39.8	30.2	32.5	18.5	64.1	41.7	42.8	27.4
MP028	36.7	31.7	34.2	27.4	26.8	15.9	57.2	35.7	36.5	25.3
MP029	37.9	30.8	32.1	27.1	28.3	17.7	59.4	40.3	40	25.2
MP030	38.7	32.7	34.2	27.5	29.4	18	63.9	42.3	42.5	28.7
MP031	33	27.1	28	23.7	24.4	15.2	60.7	38.5	37	23.4
MP032	37.1	24.9	27.8	24	24.4	16.9	55	37.2	34.8	26.3
MP033	33.7	29.2	30.9	25.7	25.9	16	62.8	40.2	36.7	23.6
MP034	32.9	26.6	28.5	24.1	24.4	15.4	60.5	38	37.8	23.6
MP035	36.3	27.3	29.4	25.8	26.8	16.9	54.4	37.4	38	26.2
MP036	32.2	24.6	26.1	22.6	22.6	15	57.2	36	35.2	24.4

CG ANTHROPOMETRIC
MEASUREMENTS

Subj.	Neck	Biceps E	Biceps F	Elbow	Forearm	Wrist	Thigh	Knee Mid	Calf	Ankle
MP037	30	22.8	24.1	21.3	22	13.5	54.5	33.3	35.2	22
MP038	31.9	25.5	27.1	23.2	23.2	15	62.7	37	33.6	22.9
MP039	28.8	23.4	24.4	20.1	21.2	14.2	50.5	30.9	31.4	21.8
MP040	40	30.9	32.9	24.6	26	15.8	57.5	38	36.7	23.8
MP041	31.6	24.4	26.5	23	23.9	14.7	54.7	32.2	31.5	21.8
MP042	41.8	31	33.9	26.8	27.9	16.9	59.4	39.1	37.7	26.3
MP043	37	31.9	34.4	26.6	27.3	16.6	57.2	38.3	37.9	25.5
MP044	31.8	22.2	23.6	23.7	23.1	14.3	50.8	33.3	32.1	22.8
MP045	32.4	25.1	26.2	24.2	24.6	15.3	56	36.6	36.5	23.5
MP046	38.2	32.1	35.2	28.7	28.4	16.5	56.3	36.7	35.6	26
MP047	31.9	25.3	26	21.8	23.4	14.3	54.4	32.3	34.5	21.7
MP048	30.5	24.1	25.9	23	22.7	14.2	54.3	34.5	34.5	21.6
MP049	37.6	32.4	34.8	27.2	28.6	16.4	58.6	38.7	39.2	27.2
MP050	37.6	28.7	30	23.8	25.3	16.9	55.2	37.1	34.4	25.7
MP051	39.2	37.4	40.6	29	30.2	17.4	57.9	37.7	37.9	26.2
MP052	41.6	36.2	39	29.3	31.2	19.2	62.7	41.6	41.6	28
MP053	41.2	32.5	35.1	26.4	27.8	17.2	62.1	37.7	37.9	26.6
MP054	30.7	24.2	24.9	22.1	22.8	14	57.4	33.7	33.1	22.2
MP055	39.7	32.2	34.1	27.9	29.4	17.6	56.7	39.9	36.9	25.8
MP056	29.9	25.3	26.8	23	23.7	13.7	49.4	31.9	31.9	21.5
MP057	36.4	30.5	32.1	24.5	25.5	15.9	52	36.5	36.3	25.4
MP058	31	24.2	25.1	23.1	23	14.5	51.4	35.4	35	23.8
MP059	31.3	24.7	26.5	22.5	22.5	14.2	51.4	32.9	31.9	23.1
MP060	37	30.8	33.4	27.4	28.4	16.5	57.6	36	36.5	25.2
MP061	29.2	22.4	24.1	20.6	21.4	13.1	52.4	33.3	35.8	22
MP062	33.2	25	28	23.5	24.6	15.3	45.5	33.8	32.2	23.5
MP063	35.9	30.5	33.2	27	27.7	16.9	56.4	39.8	37.4	26.4

CG ANTHROPOMETRIC
MEASUREMENTS

Subj.	Sitting	Eye	Acromial	Knee	Buttock	Menton	Head Lth	Head Bdth	Hand Lth	Hand Brdth	Hand Dpth
MP001	89.1	78.1	60.3	53.3	59.4	21.2	19.1	14.7	17.8	8.3	3
MP002	84.3		55.9	48.9	56.4	21.1	19	14.2	17.6	7.5	2.6
MP003	89	78.4	59	50.9	59.8	20.6	19.3	15.4	16.5	7.5	2.9
MP004	87.9	76.7	55.9	52.9	58.4	21.8	18.2	15	17.6	7.7	2.9
MP005	87.4	76.6	56.4	51.2	59.2	21.5	19.2	14.3	17.6	8.1	3.3
MP006	88.3	76.5	57.1	49.6	55.1	21.3	19.5	14.8	17.6	8.6	3.2
MP007	89.5	77.9	57.2	50.7	54.2	21.9	18.9	14.7	16.7	6.9	2.5
MP008	90	78.7	59	53.9	62.9	20.8	18.8	14.4	17.5	7.4	3
MP009	85.4	73.8	54.4	50.1	55.5	22.3	18.6	14.9	16.2	7.5	2.6
MP010	90.1	78.3	58.8	53.9	60.6	22.6	19.5	15	18.3	8.7	3.1
MP011	99.1	87.4	64.5	60.5	63.7	21.7	19.6	14.8	20.6	10.4	3.6
MP012	90.2	77.5	61.1	53	61.6	22.5	20.5	16.1	19.3	9.3	3.3
MP013	86.8	73.4	59.2	49.3	56.4	21.2	18.9	14.7	17.2	8.1	2.8
MP014	88.6	76.2	57.7	50.7	59.8	21.7	19.1	14.5	17.5	8	2.7
MP015	89	77.5	57	52.7	62	21.8	18.8	14.4	18.2	7.9	2.9
MP016	92.6	80.4	59.4	52.7	60.1	22.2	19.6	14.8	17.8	8.5	3
MP017	85.8	74.6	57.2	46.6	53.4	21.2	19.1	14.4	17.3	7.6	2.6
MP018	94.7	81.4	61.7	55.4	63.6	20.5	19.7	14.8	19	8.7	3
MP019	89.5	77.5	57.7	53.4	62.8	22	19	14.9	18.2	7.5	2.8
MP020	91.6	79.8	62.5	48	54.3	22.5	18.1	15	17.2	7.8	2.8
MP021	98.1	87.1	63.6	56.3	63.6	22.5	20.4	15.9	20.3	9.1	3.2
MP022	86.8	76	56.8	49.7	58.2	21.3	18.7	13.9	18.5	7.4	2.6
MP023	99.6	87.9	68.2	63.4	67	22.6	19.7	15.9	20.3	9.8	3.2
MP024	89.5	78	59.1	53.6	64.3	21.7	19.8	14.4	17.7	7.9	2.9
MP025	94.3	83.7	62	58.2	66.8	22.3	19.8	15.2	19.5	9.1	3.1
MP026	85.6	72.9	56.2	52.6	59.8	21.1	19.1	15.2	18.3	8.3	2.9
MP027	95.1	83.3	63.4	57.6	63.4	22.2	20.8	14.9	20.5	8.8	3.3
MP028	97	83.9	63.7	54.6	64.4	23.4	19.8	15.1	18.1	8.7	2.8
MP029	91.4	81.2	60.8	53.4	59.9	21.8	19.5	15.3	18.6	8.2	2.7
MP030	95	80.2	64.3	60.3	67.6	22.6	19.6	15.2	19.7	9.5	3.3
MP031	86.8	75.4	57.1	50.7	59.1	21.2	19	14.6	16.3	7.8	2.8
MP032	95.6	83.6	62.1	55.5	56.9	22.6	19.7	14.4	20.5	8.5	3
MP033	90.9	79.5	61	52	58	21	18.4	14.4	17.5	7.6	2.7
MP034	86.7	75.8	59.9	47.6	55.3	21.2	19.1	14.8	15.8	7.5	2.8
MP035	92.4	82.2	60.4	55	59.4	21.1	20.4	15	19.3	8.5	3
MP036	88.8	77.5	60.9	53	59.6	21.2	19.5	14.1	18.2	7.7	2.8

CG ANTHROPOMETRIC
MEASUREMENTS

Subj.	Sitting	Eye	Acromial	Knee	Buttock	Menton	Head Lth	Head Bdth	Hand Lth	Hand Brdth	Hand Dpth
MP037	82.2	69.9	52.5	45.6	54	21	18.7	14.1	15.2	6.9	2.6
MP038	87	75.9	56.6	52.7	61.4	21.3	17.6	14.1	17.5	7.9	2.9
MP039	79.9	67.5	51.2	43.7	50.1	19.9	18.4	14.6	15.3	6.7	2.4
MP040	89	77.7	59.3	50.3	58.9	21.1	18.8	16.2	16.6	7.6	2.6
MP041	86.7	74.6	58	48.2	52.2	20.1	18.4	14.5	16.7	7.6	2.7
MP042	92	81	59.6	54.9	62.1	21.5	19.3	15.6	19.2	8.4	2.8
MP043	91.7	80.7	61.8	53.5	57.7	21.3	20.3	15	18.9	8.5	3.3
MP044	91.6	79.5	60.1	54	60.1	20.6	19.4	13.6	17.7	7.6	2.7
MP045	89	78.2	57	51.6	60.2	21.6	19.5	14.7	18.5	7.8	2.6
MP046	95	83.9	59.4	57.1	63.6	21.7	20.5	14.6	19	8.6	3.1
MP047	85.6	73.5	54	45.1	53.1	21.1	19.2	14.9	16.1	7.4	2.4
MP048	85	74.3	52.9	45.7	52	20.3	18.3	14.1	15.4	7.4	2.7
MP049	93	81.3	60.8	53.6	59.8	21.3	21	15.2	19.4	8.7	2.8
MP050	91.2	81.8	61.8	51.2	57.3	20.8	19.7	15	17.7	8.7	3.1
MP051	92.6	81.5	61.2	54.8	61.7	21.2	19.9	15.1	18.9	9	2.8
MP052	95	82.8	60.9	55.2	61.8	21.8	21.7	16.8	19.7	9.5	3.1
MP053	100.3	89.2	68.4	57.8	64.4	22.7	20.1	16.1	19	8.9	2.9
MP054	82.4	71.9	53	48.9	56.5	20.3	19	14.1	16.6	7.2	2.6
MP055	93.5	83.1	60.5	56.3	62.7	21.9	20.2	15.4	19.6	9	3.3
MP056	84.7	73.7	56.3	47.7	54.4	19.6	18.6	13.7	17.1	7.1	2.7
MP057	90.5	79.5	58.2	49.2	54.8	19.3	19.3	14.6	17.8	8.2	2.8
MP058	86.8	75.1	55.9	53.8	59.5	20.8	19.1	14.4	17.9	7.4	2.7
MP059	81.4	70.2	53.7	47.3	54.4	20	17.3	14.7	16.6	7.4	3
MP060	91.3	81.1	59.6	56.8	66.2	19.3	19.9	15	19.1	7.9	3
MP061	83	73.1	52.6	45.6	52.4	19.8	18.2	14	14.5	6.8	2.5
MP062	88.5	77.5	58.6	52.7	57.8	21.3	18.9	14.8	17.8	7.5	2.7
MP063	99.1	87.7	67.1	57.7	62.2	21.3	19.6	15	20.2	8.9	3.1

APPENDIX D

LIST OF ALL ZIPPERED FILES

Zippered Files			161 Scans	54 Subjects				
cg01a.ply	cg11a.ply	cg19b.ply	cg26c.ply	cg33a.ply	cg39b.ply	cg46b.ply	cg52c.ply	cg59a.ply
cg01b.ply	cg11b.ply	cg19c.ply	cg27a.ply	cg33b.ply	cg39c.ply	cg46c.ply	cg53a.ply	cg59b.ply
cg01c.ply	cg11c.ply	cg20a.ply	cg27b.ply	cg33c.ply	cg40a.ply	cg47a.ply	cg53b.ply	cg59c.ply
cg06a.ply	cg14a.ply	cg20b.ply	cg27c.ply	cg34a.ply	cg40b.ply	cg47b.ply	cg53c.ply	cg60a.ply
cg06b.ply	cg14b.ply	cg20c.ply	cg28a.ply	cg34b.ply	cg40c.ply	cg47c.ply	cg54a.ply	cg60b.ply
cg06c.ply	cg14c.ply	cg21a.ply	cg28b.ply	cg34c.ply	cg41a.ply	cg48a.ply	cg54b.ply	cg60c.ply
cg07a.ply	cg15a.ply	cg21b.ply	cg28c.ply	cg35a.ply	cg41b.ply	cg48b.ply	cg54c.ply	cg61a.ply
cg07b.ply	cg15b.ply	cg21c.ply	cg29a.ply	cg35b.ply	cg41c.ply	cg48c.ply	cg55a.ply	cg61b.ply
cg07c.ply	cg15c.ply	cg22a.ply	cg29b.ply	cg35c.ply	cg42a.ply	cg49a.ply	cg55b.ply	cg61c.ply
cg08a.ply	cg16a.ply	cg22b.ply	cg29c.ply	cg36a.ply	cg42b.ply	cg49b.ply	cg55c.ply	
cg08b.ply	cg16b.ply	cg22c.ply	cg30a.ply	cg36b.ply	cg42c.ply	cg49c.ply	cg56a.ply	
cg08c.ply	cg16c.ply	cg23a.ply	cg30b.ply	cg36c.ply	cg43a.ply	cg50a.ply	cg56b.ply	
cg09a.ply	cg17a.ply	cg23b.ply	cg30c.ply	cg37a.ply	cg43b.ply	cg50b.ply	cg56c.ply	
cg09a.rgb	cg17b.ply	cg23c.ply	cg31a.ply	cg37b.ply	cg43c.ply	cg50c.ply	cg57a.ply	
cg09b.ply	cg17c.ply	cg24a.ply	cg31b.ply	cg37c.ply	cg44a.ply	cg51a.ply	cg57b.ply	
cg09c.ply	cg18a.ply	cg24b.ply	cg31c.ply	cg38a.ply	cg44b.ply	cg51b.ply	cg57c.ply	
cg10a.ply	cg18b.ply	cg24c.ply	cg32a.ply	cg38b.ply	cg44c.ply	cg51c.ply	cg58a.ply	
cg10b.ply	cg18c.ply	cg26a.ply	cg32b.ply	cg38c.ply	cg45a.ply	cg52a.ply	cg58b.ply	
cg10c.ply	cg19a.ply	cg26b.ply	cg32c.ply	cg39a.ply	cg46a.ply	cg52b.ply	cg58c.ply	